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Reprinted from PSYCHE, Vol. 82, No. 3-4, September-December 1975
pages 306-314

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MIXED NESTS OF *CONOMYRMA INSANA* AND *C. FLAVOPECTA* — EVIDENCE OF PARASITISM (HYMENOPTERA: FORMICIDAE)[1]

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Ants of the dolichoderine genus *Conomyrma* are abundant in Florida. The nests are in the ground with the usually single nest opening surrounded by a rather uniformly constructed crater approximately 7 to 18 cm in diameter. Open areas in sandy soil with little vegetation are usually preferred as nesting sites. The ants often forage in full sunlight and move rapidly and seemingly erratically. Further information on the general biology of the ants is given by Nickerson et al. (1976).

Two common species occur in Florida. We have, for the present, identified these species as *Conomyrma insana* (Buckley) and *C. flavopecta* (M. R. Smith), following the revision of Snelling (1973) and the identification criteria given by Creighton (1950). The 2 species differ in color, morphology, and biology. *C. insana* is nearly uniformly dark, greyish black, has a broad, straight, or slightly concave occipital border, and has a distinct declivity on the mesonotum seen in profile, while *C. flavopecta* is light yellowish brown, with the head and apex of gaster weakly to moderately infuscated, the occipital border rounded or straight only medially, and the mesonotum in profile evenly convex without trace of a declivity. Colony structuring differs markedly in the 2 species as shown by Nickerson et al. (1976). *C. insana* exists in enclaves of multiple nests with much traffic between the nests, transfer of brood, food exchange, and many queens localized together in only 1 of many nests, while in *C. flavopecta* there is no traffic between the nests or food exchange and a single queen per nest. These consistent data are postulated by Nickerson et al. (1976) as solid evidence that colonies of *C. insana* are polydomous whereas colonies of *C. flavopecta* consist only of a single nest. Thus the differences between the 2 taxa in all respects are striking, and the evidence that 2 distinct species are involved seems unequivocal.

[1]Florida Agricultural Experiment Station Journal Series 6080.
Manuscript received by the editor October 1, 1975.

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Reactions between the 2 species in the field are entirely inimical (observations of the writers). When workers of the 2 species meet (in accidental meetings as far as we can judge), the *C. insana* worker usually holds its ground and may open its mandibles, while the *C. flavopecta* worker almost immediately breaks contact and runs rapidly and erratically away. We term this reaction "panic retreat" paralleling the terminology of Wilson and Regnier (1971) who distinguish between "panic alarm" and "aggressive alarm" reactions in ants. Movements during panic retreat are more rapid and erratic than during normal foraging. In contrast, accidental or other contacts between *C. insana* workers never, in our observations, lead to antagonistic or panic retreat reactions. Chance encounters between 2 foraging *C. flavopecta* workers can either be non-antagonistic or can initiate panic retreat (sometimes both workers displaying this behavior) according, we presume, to whether the meeting is between workers of the same colony or from 2 different colonies.

With these uniformly different behavioral patterns, it has been rather surprising to discover on several occasions and places in Florida mixed colonies of the 2 species. The specific records for these mixed nests are as follows: Highlands Co., Archbold Biological Station, Lake Placid, 18 April 1973, J. C. Nickerson; Polk Co., Winter Haven, Camp's citrus grove, 19 April 1973, J. C. Nickerson; Polk Co., Winter Haven, Camp's citrus grove, 13 April 1974, J. C. Nickerson; Alachua Co., Gainesville, Depot Road, 30 April 1974, J. C. Nickerson; Alachua Co., Gainesville 15 May 1974, Wm. F. Buren; Alachua Co., Gainesville, 10 April 1975, J. F. Carroll; Alachua Co., Gainesville, 23 May 1975, Wm. F. Buren; Wakulla Co., Medart, 20 June 1975, D. P. Wojcik.

In all of the mixed nests, workers of both species were observed participating in normal activities as nest-mates (foraging, casting out soil particles, moving together in the nest burrows, brood tending, etc.) without antagonism. The mixed nests were never a part of an established enclave of unmixed *C. insana* nests but could be as close as 10 m from such an enclave or could be 1 of a number of separate nests in a field in which all or most of the other *Conomyrma* nests were unmixed *C. flavopecta*. We interpreted these observations and records as an indication that temporary parasitism might be occurring in these ants.

Temporary parasitism is very well known in ants, especially in the subfamilies Formicinae and Myrmicinae (see excellent reviews by Wheeler 1910 and Wilson 1971). In the subfamily Dolichoderi-

nae, species of the genus *Bothriomyrmex* are temporary parasites on species of *Tapinoma* (Santschi 1906, Wilson 1971). Several species of the genus *Azteca* are also suspected of being temporary parasites because they have microgynous queens (Wheeler 1910) and therefore cannot be expected to employ the usual claustral method of colony establishment. There has been no previous suspicion that parasitism was occurring in *Conomyrma,* however.

Most of the material in the next 3 paragraphs has been reviewed by Wilson (1971), but we touch on this briefly again in order to introduce our lines of thought.

In many temporary parasitic ants, adoption of the parasitic queen by a host colony appears difficult and not too often successful. Mixed nests of these species and their hosts are rare or uncommon. Nevertheless, the parasitic species may become locally abundant by the process of colony fission (hesmosis) to form an enclave of closely spaced interconnected nests. Further adoption of newly mated parasitic queens, additional to the original parasitic queen, seems a logically necessary step in the growth of such an enclave. Colony "towns" of such ants often have been noted by observers. In the case of the allegheny mound building ant, *Formica exsectoides* Forel, enclaves of up to 1700 individual nests have been recorded (Wheeler 1901). Nickerson (unpublished) has studied localized enclaves of an estimated 200 to 400 nests of *Conomyrma insana* at Tall Timbers Research Station north of Tallahassee, Fla.

Queens of temporary parasitic species are all modified in lesser to greater degree. In many species this modification is shown merely by modest enlargement of the head and reduction of the gaster in relation to the thorax. In other examples the mandibles may be strongly modified to form falcate, piercing organs, or the whole insect may be very small (microgynous) in relation to the workers and/or may have various other characteristics such as modified pilosity or integument (Wilson 1971). Myrmecologists familiar with a number of these modified females can often guess that a species is a temporary parasite merely by examination of the queens. In contrast, females of free living species which practice the normal claustral method of new colony formation almost uniformly have voluminous gasters and relatively small heads with mandibles, pilosity and integument not modified from the norm for the genus.

The actual step by step methods by which the parasitic queens attempt to gain adoption by host colonies has been observed for only a few of the temporary parasitic species (reviewed by Wilson 1971).

The details of the behavior appear to vary considerably but the general patterns and results are quite similar. The newly mated parasitic queen approaches the host colony, is "discovered" by the host workers, and then according to the particular species, either adopts so-called "conciliatory" reactions to these workers, or else fights with them and "intimidates" them. In either case, if she is successful and not killed by the host workers, she enters the host colony and gradually is accepted and finally adopted as the colony queen. During this process the host queen is eliminated by various methods. In most cases this appears to be by assassination, the parasitic queen killing the host queen by strangulation, cutting off her head, or other means according to the particular species. The adopted parasitic queen then begins to lay eggs. The host workers care for the parasitic brood as they would for their own, and the newly reared parasitic workers work side by side with the host workers in a mixed nest until normal attrition of the host workers in time leaves the parasite in an unmixed colony. There is no reported evidence that the host workers are ever subjected to overt suppression by the parasitic workers or treated as anything but nest-mates.

As stated above, the mixed nests of *C. insana-flavopecta* found in Florida and the localized enclaves of *C. insana* appeared to us to give presumptive evidence that temporary parasitism followed by hesmosis was occurring in these ants. Further evidence may be given by the morphology of the queens. In queens of *C. insana* the head is large, wider than the thorax, while the gaster is rather small and slender in alate queens. In *C. flavopecta* queens, however, the head is of moderate size, about equal in width to the thorax, and the gaster is large and voluminous in both alate and dealate queens. The morphological modifications of the *C. insana* queens therefore seem to be similar to the modifications already known for many temporary parasitic ants.

The existence of incipient nests is excellent evidence that a species has the normal claustral type of new colony establishment. Incipient nests of *C. flavopecta* have been found several times at Gainesville, Fla. by the senior author whereas no incipient nests of *C. insana* have been found in Florida even with intensive search over a period of several years by Nickerson (unpublished). Two incipient nests of *C. flavopecta* excavated by the senior author consisted of a single *C. flavopecta* queen and less than 20 nanitic workers (all specimens not captured for accurate count) in each nest. Incipient nest craters of *C. flavopecta* are very small (radius less than 2 cm) and are

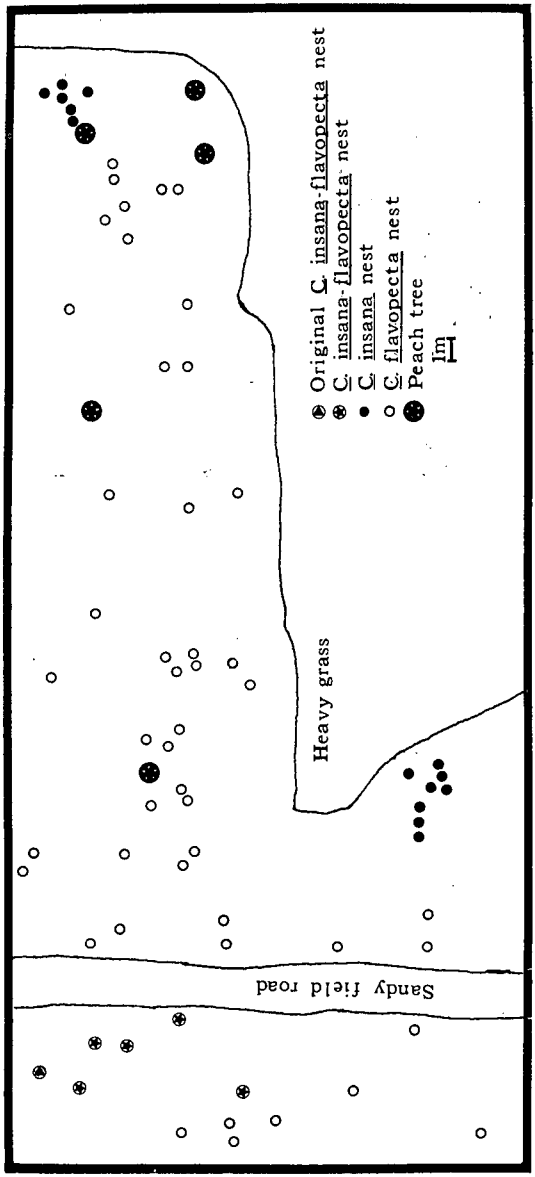

Fig. 1. Condition of study area 1 June to 10 June 1975, showing (1) location of original excavated *Conomyrma insana-flavopecta* nest, (2) additional mixed *C. insana-flavopecta* nests found several days after excavation, (3) small, localized enclaves of *C. insana* nests, and (4) scattered occurrence of *C. flavopecta* nests.

flattened and lunate rather than complete. The nest openings are very small (approximately 1.5 mm) compared to other *Conomyrma* nests and are blocked with soil diurnally. The tiny workers only forage nocturnally. We suspect the small, blocked nest entrances and nocturnal foraging habits may be adaptations which allow these incipient colonies to coexist near larger nests of their own species without excessive competition. In full sized nests of *C. flavopecta* the workers usually forage diurnally and the nest entrances are sometimes blocked nocturnally.

In the interest of keeping a permanent record of the mixed nest phenomenon and in seeking other data, 1 of these nests, found in the experimental farm area at the University of Florida on 23 May 1975, was excavated and collected as thoroughly as possible. Three hundred twenty-six *C. flavopecta* workers and 726 *C. insana* workers were collected from this nest and have been deposited as a voucher series in the Florida State Collection of Arthropods, Gainesville. A single dealate queen also was captured in the nest, and in confirmation of our hypothesis, was a queen of *C. insana* rather than *C. flavopecta.* All pupae (approximately 75) mature enough to identify (by head shape) were *insana* rather than *flavopecta* and all callow workers found (36) were also *insana.*

The data suggest that *C. insana* is a temporary parasite of *C. flavopecta.* The modus operandi for the adoption of the parasitic queen, elimination of the host queen, formation of the mixed nest, and eventual maturation to an unmixed *insana* nest must be similar in a general way to numerous other temporary parasitic ant species. The findings that a *C. insana* queen was the only queen found in the mixed nest and that only brood of *C. insana* and young adults of *C. insana* were present strongly suggests that the *C. flavopecta* queen had already been eliminated.

Distributional patterns of the ants at the Gainesville location are shown in Figs. 1 and 2. All unmixed *C. insana* nests appear to be clustered into localized enclaves, whereas the unmixed *C. flavopecta* nests have a more scattered but probably not random spacial arrangement. Small peach trees present in the study area do not appear to influence the distribution patterns. No *Conomyrma* nests were found in an area of high, dense grass, however.

The distribution of the mixed *C. insana-flavopecta* nests needs explanation which we cannot give at this time. The original mixed nest in the study area was found on 23 May 1975. It was excavated and collected on 27 May. On 1 June to 10 June the area was

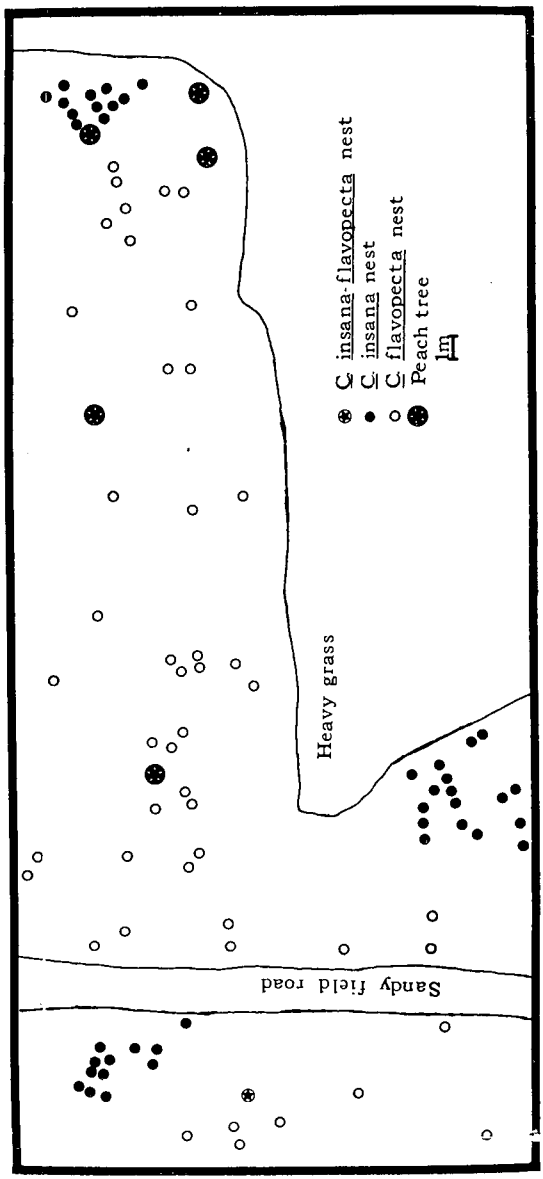

Fig. 2. Condition of study area on 26 June 1975 showing growth of the *C. insana* enclaves and appearance of a new enclave of *C. insana* in the same area as the previously present mixed nests, while the unmixed *C. flavopecta* nests appear to have remained unchanged.

mapped and the distribution of the 3 types of nests determined as shown in Fig. 1. Although the ratio of *C. insana* to *C. flavopecta* workers in the original mixed nest was about 7 to 3, the ratios of *C. insana* to *C. flavopecta* in the mixed nests observed at the time of mapping was about 20 to 1, judging from the workers appearing at the nest entrances (no further nests were excavated, however). The area was mapped again on 26 June (Fig. 2). Although the unmixed *C. flavopecta* population appears stable, obvious changes occurred in the *C. insana* population. The numbers of individual nests in the unmixed *C. insana* enclaves increased, there was a new enclave of unmixed *C. insana* in the area formerly occupied by the mixed nests, and only 1 mixed nest could still be found, this one with an estimated 100 to 1 *insana* to *flavopecta* ratio.

The speed of the change over from the mixed nests to the new unmixed *C. insana* enclave was surprising to us and we have no unequivocal explanation for this phenomenon. Although we observed no overt actions of the *C. insana* workers against *C. flavopecta* in the mixed nests, the death rate or attrition of the latter may be greater than normal for reasons we do not understand. We also have no certain explanation for the clustering of the mixed nests in one small part of the study area. Perhaps the process of hesmosis begins to occur even while the nests are still mixed. Obviously one or more additional *C. insana* queens were present in these mixed nests, because the new *C. insana* enclave proceeded in its development even after the *C. insana* queen found in the original nest was removed.

This is the first report of temporary social parasitism in the genus *Conomyrma*. It may be noted that mixed nests of *Conomyrma* have been recorded (as *Dorymyrmex*) previously by Wheeler (1901) who gave the remarks of Forel upon finding mixed nests of ants identified as *Dorymyrmex pyramicus* var. *niger* Pergande and *D. pyramicus* var. *flavus* McCook near Faisons, North Carolina. Forel attributed these mixed nests to a queen of each taxon fortuitously associating together when first founding a new colony. Such a chance association of 2 species of females has never been confirmed for any ants as far as we are aware, although reported in older literature (Forel 1874, Wheeler 1901). In the Forel colonies all alates found were identified as *niger* except for 1 male which Forel identified as *flavus* on the basis of color. In the absence of any positive statement, we assume no dealate queens were found to confirm Forel's hypothesis.

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